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Bruinsma, F.R.; Rienstra, S.A.; Rietveld, P.

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Economic Impacts of the Construction of a Transport Corridor: A Multi-level and Multiapproach Case Study for the Construction of the A1 Highway in the Netherlands

Frank R. Bruinsma [a], Sytze A. Rienstra [a] & Piet Rietveld [a]
[a] Department of Regional Economics, Free University, De Boelelaan 1105, Amsterdam, 1081 HV, the Netherlands

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Economic Impacts of the Construction of a Transport Corridor: A Multi-level and Multi-approach Case Study for the Construction of the A1 Highway in the Netherlands

FRANK R. BRUINSMA, SYTZE A. RIENSTRA and PIET RIETVELD
Department of Regional Economics, Free University, De Boelelaan 1105, 1081 HV Amsterdam, the Netherlands

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BRUINSMA F. R., RIENSTRA S. A. and RIETVELD P. (1997) Economic impacts of the construction of a transport corridor: a multi-level and multi-approach case study for the construction of the A1 highway in the Netherlands, *Reg. Studies* 31, 391–402. In this paper the relation between the construction of highway infrastructure and regional economic development is analysed at two spatial levels: the level of regions and individual entrepreneurs. Three different approaches are used: a regional labour market model; a reference region approach; and a survey among entrepreneurs. Both the regional models gave no clear indication of an impact of highway construction on regional economic development. At the level of individual entrepreneurs the impact of the highway construction was clearly positive for the level of corporate investments, the number of employees, the perceived accessibility, travel time and the accuracy in delivery times. Perceptions deserve attention in studies of this type, because behaviour is not only governed by objective facts, but also by subjective perceptions.

Regional development Highway construction Infrastructure Transport Corridor

BRUINSMA F. R., RIENSTRA S. A. et RIETVELD P. (1997) Les retombées économiques de la construction d'un couloir de transport: un cas d'étude à plusieurs niveaux et façons pour la construction de la route nationale A1 aux Pays-Bas, *Reg. Studies* 31, 391–402. Cet article cherche à analyser le rapport entre la construction de l'équipement de transport et l'aménagement du territoire à deux niveaux géagraphiques; à savoir sur le plan régional et du point de vue des entrepreneurs. On se sert de trois façons différentes: un modèle du marché du travail régional, une façon qui comporte une région de référence et une enquête menée auprès des entrepreneurs. Aucun des modèles régionaux n'a indiqué clairement que la construction d'une route nationale a des retombées sur l'aménagement du territoire. Du point de vue des entrepreneurs, les retombées de la construction d'une route nationale se sont avérées clairement positives quant au niveau des investissements d'entreprise, à l'effectif, à l'accessibilité perçue, au temps du parcours et à l'exactitude des délais de livraison. Les perceptions méritent quelque réflexion dans des études de ce genre parce que le comportement se voit déterminer non seulement par des faits objectifs, mais aussi par des perceptions subjectives.

Aménagement du territoire
Construction d'une route nationale
Equipement Transport Couloir

BRUINSMA F. R., RIENSTRA S. A. und RIETVELD P. (1997) Wirtschaftliche Auswirkungen des Baus eines Transportkorridors: eine Fallstudie des Baus der A1 Verkehrsstraße in den Niederlanden auf mehreren Ebenen und aus mehrfachen Blickwinkeln, *Reg. Studies* 31, 391–402. In diesem Aufsatz wird die Beziehung zwischen dem Bau einer Verkehrsstraßeninfrastruktur und regionaler Wirtschaftsentwicklung auf zwei räumlichen Ebenen analysiert, der Ebene der Regionen und der des individuellen Unternehmers. Dazu werden drei verschiedene Ansätze benutzt: ein regionales Arbeitsmarktmodell, ein Regionalbezugsansatz und eine Umfrage unter Unternehmern. Bei keinem der beiden Regionalmodelle gab es klare Anzeichen einer Auswirkung des Baus der Verkehrsstraße auf die regionale Wirtschaftsentwicklung. Auf der Ebene der individuellen Unternehmer hatte die Verkehrsstraße eine deutlich positive Wirkung auf die Höhe korporativer Investierungen, die Zahl der Beschäftigten, die empfundene Erreichbarkeit, Wegzeit und genaue Einhaltung von Lieferzeiten. In Untersuchungen dieser Art verdienen Auffassungen Beachtung, denn Verhalten wird nicht nur von 'objektiven Tatsachen' bestimmt, sondern auch von subjektiver Wahrnehmungen.

Regionale Entwicklung Bau einer Verkehrsstraße
Infrastruktur Transport Korridor

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INTRODUCTION

Low levels of transport infrastructure investments in the 1980s in most industrialized countries have stimulated discussions about the need to increase investment levels in the 1990s. In addition to environmental aspects that have become increasingly important in such discussions, economic aspects have also recently received much attention.

Basically three approaches can be distinguished in the literature on the economic impact of transport infrastructure. The first approach is the well known social cost benefit analysis (CBA) with *consumer surplus* as the main object. This approach is firmly based on efficiency objectives in welfare economics and has been widely used in various countries.

More recently a second approach has emerged where consumer surplus is no longer the basic concept, but *productivity* is (see ASCHAUER, 1989). Implicit in this approach seems to be that CBA is sometimes regarded as too broad because its outcome may strongly depend on the travel time savings of households which do not have implications for GDP. On the other hand CBA outcomes are sometimes regarded as too narrow because, in the calculations of the benefit, the strategic long term macro-economic benefits in terms of GDP are only partially taken into account.

The third approach moves even further away from CBA by focusing on *employment*. This happens especially in countries with high levels of structural unemployment where job creation is considered of prime interest. In this approach the spatial dimension is often relevant: transport infrastructure investments have spatially differentiated impacts on employment.

Of course, the three approaches are not entirely independent; they are partially overlapping, partially conflicting, and partially complementary. In the present paper we will not go into these interrelationships, but mainly contribute to the third approach by focusing on employment aspects of transport infrastructure; in addition some attention will be paid to the second approach.

After a brief discussion in which the relationship between transport infrastructure and spatial patterns of economic activities is sketched from a theoretical perspective (next section), the focus of the article will shift to some methodological issues (third section). As will be shown, a variety of approaches at different spatial levels of aggregation have been applied in research in this field. The results obtained with those approaches are rather diffuse. In the fourth, fifth and sixth sections the empirical results are presented of a study on economic impacts of the construction of the transnational A1 highway on Dutch regions. In this study various methods have been used at various levels of spatial detail.

THEORETICAL FRAMEWORK

In Fig. 1 the complex relationship between transport infrastructure and regional economic development is presented (BRUINSMA, 1994). The construction of transport infrastructure influences transport costs by means of a reduction of distances and/or a higher average speed (relation 1). This will lead to changes in the choice of transport mode, route choice, time of departure (in the case of congested networks) and the generation or attraction of new movements per zone (relation 2).

The reduction in transport costs combined with the changes in the patterns of movements of households and firms will lead to an increase in the productivity of the zones involved (relations 3 and 4). Another consequence is an increase in accessibility (relation 5). The accessibility of a zone depends on all possible efforts necessary to visit or leave this zone. The increase in productivity and accessibility in a certain zone may result in an expansion of the economic activities and/or population within the zone (relations 6 and 7).

So far only direct links between the construction of transport infrastructure and the spatial pattern of economic activities have been discussed. However, there are also a number of indirect–feedback–relations which are important. A first feedback concerns the relocation of economic activities, which results in changes in the masses of the zones involved. This may again have impacts on the accessibility of the zones (relation 8). The changes in the location of economic activities influence the number of movements of freight and passengers in a similar way (relation 9). In the case of congestion, this shift in the number of movements of freight and passengers implies changes in transport costs too (relation 10).

Transport infrastructure cannot be seen as completely exogenous since it is developed by the government. The government reacts to changes in the transport system. The main target of government infrastructure policy may be to secure an acceptable level of accessibility for each zone (relations 11 and 12). On the other hand, economic policy might be oriented towards the development of additional transport infrastructure in zones with a relatively positive economic development, for instance to overcome congestion.

A last element in Fig. 1 concerns the fact that new transport infrastructure is not the only important influence on the development of traffic flows and the spatial pattern of economic activities. In general, factors like technology, demography, economy, and environmental and public policy may be mentioned (relation 13). Those factors shape a wider context in which the relationship between transport infrastructure and the spatial pattern of economic activities has to be seen.

Thus we end up with a rather complex model with various feedbacks. As a result, the impacts of transport infrastructure improvement on the economy are not always easy to determine. This can also be understood from related theoretical frameworks. For example, interregional trade theory shows that a positive impact of a decrease of interregional transport costs on employ-

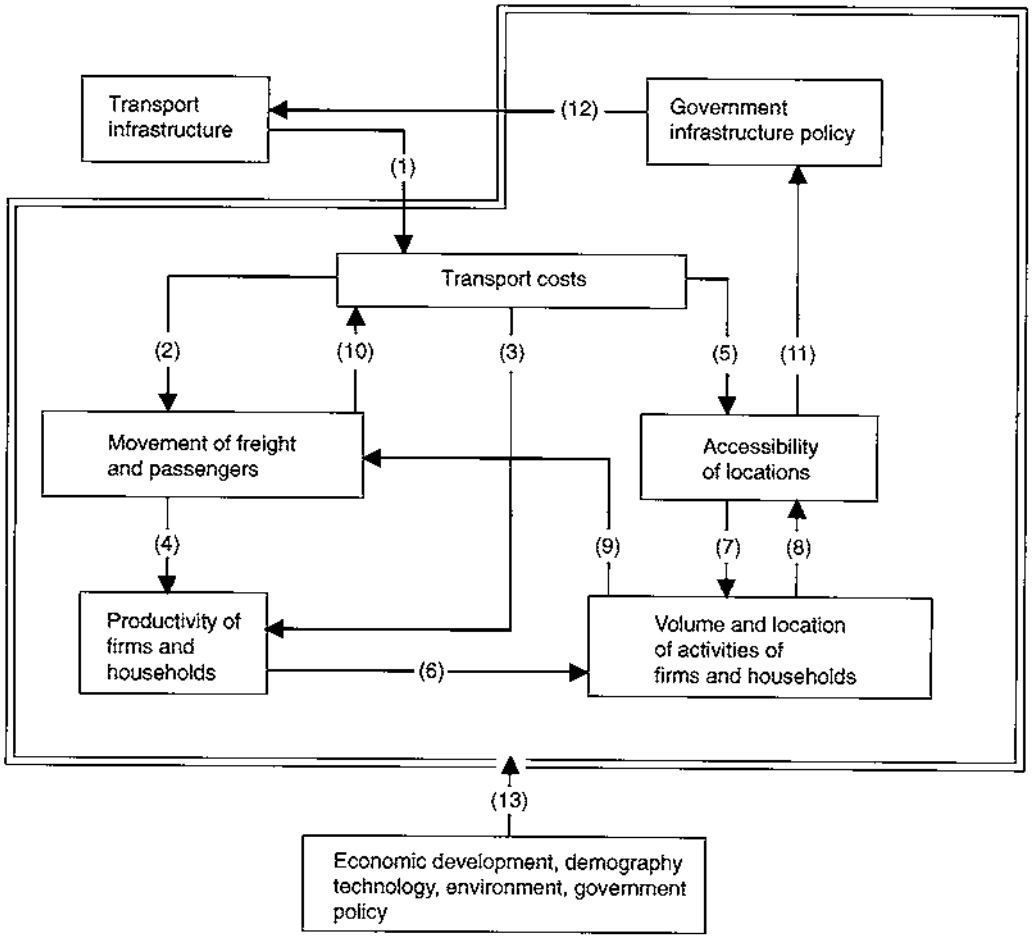

Fig. 1. *Conceptual model on the relation between transport infrastructure and the spatial pattern of economic activities*

ment in a particular region is not guaranteed. A reduction of these costs leads to an increase of interregional competition. Local and regional production may be replaced by imports from competitive regions. The induced specialization process may prove to be disadvantageous for employment in low productivity regions.

EMPIRICAL APPROACHES

In this section a concise summary is presented of approaches which are in common use in empirical research to trace the impact of new infrastructure on spatial patterns of economic activities. A diagramatic overview of approaches is given in Table 1. The approaches applied later on in the empirical part of this article are presented in italics. In the table a twofold subdivision is employed. First, there is a subdivision between models and non-model approaches. Second, there is a subdivision based on the spatial level of aggregation of the data input. In order to emphasize the variety of these approaches we give below some short comments on their particular features. For a broader review refer to VICKERMAN, 1991; BRUINSMA, 1994; RIETVELD, 1994.

Models based on aggregate data

This type of model is mainly used by transport engineers, urban planners and economists. Integrated transport-land use models, for example, have mainly been developed by urban planners and transport engineers. These models can be considered as an extension of the well known urban transport models where a feedback is formulated from the transport system to employment and population growth in the various zones. An overview of those models is presented in WEBSTER *et al.*, 1988.

Another example is the production function approach, which has become very popular among economists after the work of ASCHAUER, 1989. In the production function approach the level of production depends on the classic private production factors – capital and labour – supplemented with a (transport) infrastructure variable (see BIEHL, 1986, for an example at the European level).

In location models the impact of transport infrastructure is analysed together with other factors that may influence the location of firms like the price of labour, investment subsidies, sectoral structure, and accessibility of markets. The main target in a location

Table 1. Examples of research methods used to study economic impacts of transport infrastructure investments

	Models	Other approaches
Aggregate data	Transport land use models Production function models *Location models* Interregional trade models General equilibrium models	*Quasi experimental*
Disaggregate data	Stated preference models *Revealed preferenæ models*	Quasi-experimental *Entrepreneur survey* Expert judgement Calculation of the impact of infrastructure on transport costs

model is to explain the changes in private investments and/or employment by those location factors (see for instance EVERS *et al.*, 1987).

Models based on disaggregate data

Revealed and stated preference approaches are most common for studying the impact of transport infrastructure on spatial patterns of economic activities with models using data on a disaggregate level. These approaches may be applied at different spatial levels. Both approaches are based on individual utility functions. In the case of revealed preference models the utility function is estimated with data concerning choice behaviour in actual situations. In the case of stated preference models the data concern the preferred behaviour of respondents who made a choice in a laboratory situation.

Both methods have their strengths and their weaknesses as documented in the literature (KROES and SHELDON, 1988). Revealed and stated preference models have to be seen as complementary rather than conflicting, since each provides complementary information and avoids the weaknesses of the other.

Other approaches based on aggregate data

The quasi-experimental approach is an example of a non-model approach based on aggregate data. In this approach the development in a region is analysed after an improvement in its infrastructure. This development is compared with the development in the region before the improvement and/or with a group of reference regions. The choice of appropriate reference regions is vital for the quality of this approach (ISSERMAN, 1990).

Other approaches based on disaggregate data

One of the non-model approaches that is commonly used among geographers concerns suveys among entrepreneurs. The surveys may be postal questionnaires, telephone or face-to-face interviews. These surveys allow the receipt of information from entrepreneurs about various subjective elements, including perceptions and expectations. These aspects are certainly relevant for this type of research but are usually ignored in model type studies.

This short survey of research approaches reveals that widely different methods are used to address the issue of transport infrastructure impacts on the economy. These methods differ in terms of: theoretical background; the type of data used; the spatial level of analysis and dependent variable (productivity versus employment). It is therefore not surprising that these approaches sometimes lead to rather different outcomes (see OFFNER, 1992). It is therefore recommended that in studies on this subject various approaches are used. An example of such a multi-method approach is presented in the next setions.

A CASE STUDY: THE CONSTRUCTION OF THE A1 HIGHWAY

The A1 transport corridor

The highway network in the Netherlands has mainly been constructed in the last 30 years. During the same period a strong increase of the mobility level and the traffic intensity on the network occurred. Nowadays the Netherlands is covered by a highway network which, in Europe, is exceeded only by the Belgian network in density.

In such an extensive network a new link will usually only have limited impact for the network in total, so that the expected spatial economic impacts will be small. An exception to this may be transnational links. Using a European perspective BRUINSMA and RIETVELD, 1994, showed, for example, that such links are relatively scarce in most networks. An example in the Netherlands of a transnational corridor that was created only recently is the A1 highway. This highway connects the relatively poorly accessible eastern part of the country with the national and international road network (Fig. 2). The A1 is one of the most important east–west axes in the Dutch road network and also provides a main connection to the German road network. In Germany this highway runs as E8 to Berlin

Fig. 2. Research area

and Poland. It is also one of the main routes towards the Scandinavian countries.

The construction of the A1 from Amsterdam up to Twente took place between 1970 and 1975. Then the construction came to a virtual standstill: the section up to Hengelo was opened in 1979, the remaining sections up to the German border were constructed in small sections between 1985 and 1992. Almost all these sections have been constructed as entirely new links, only the section Oldenzaal-German border is an upgrading of the existing road.

The research area

The A1 highway crosses three Corop regions – a statistical unit between the level of provinces and municipalities – between Apeldoorn and the German border: the Veluwe; Southwest-Overijssel; and Twente (Fig. 2). To analyse the impacts of the highway construction it is important to know something about the economic development of the area. The analysis will be limited to the period 1970–90, because the A1 construction took place in this period.

After 1970 a recession occurred in the Western world and also in the Netherlands. In the second half of the 1980s, however, a strong recovery manifested itself. In the observed period changes also took place in the sectoral structure of the economy. During the period considered, the share in employment of the industry sector in the Dutch economy decreased from 42% to 29%, while the share of the services sectors increased from 42% to more than 54%.

In spatial terms a deconcentration process took place. The economic development of the Randstad area (see Fig. 2) was slightly below the national average. The so-called intermediary zone developed favourably, while the peripheral zone experienced a less positive development. The intermediary zone is defined by the area between the central Randstad regions and the peripheral regions in the Netherlands. The research area chosen is located in the intermediary zone which experienced – with the Twente region as a possible exception – relatively favourable economic development.

In order to correct for sectoral composition effects in the growth of employment, one might use shift-share analysis (ARMSTRONG and TAYLOR, 1986). The differential shifts of the A1 regions are presented in Table 2. It appears that the Veluwe had the most favourable economic development, while the differential shifts of Twente appear to be less favourable. The high shifts in the Veluwe are mainly explained by the rapid growth of the service sector in this region where, in the period 1970–75 particularly, defence employment grew rapidly. The economy of Southwest-Overijssel on the other hand has a high share of the industry sector, while the service sector is relatively small. In the analysed period one can clearly observe a convergence of the regional production structure in these two regions towards the national average. This does not hold true for Twente to the same extent. This region has traditionally been oriented towards industry (mainly metal manufacture and textiles). The employment in the textile industry decreased rapidly because of many reorganizations. When the figures are corrected for the sectoral structure, however, Twente also appears to have a positive differential shift in most periods.

Table 2. Differential shift in the intermediary zone, the A1 regions and the reference regions (corrrected by sectoral structure)

	1970–75	1975–80	1980–85	1985–90
Intermediary zone	0·05	0·01	0·02	0·04
Veluwe	*0·10*	−0·00	0·02	0·05
Reference region:				
Achterhoek	0·05	0·05	−0·04	0·07
Southwest-Overijssel	*0·01*	0·02	−0·02	0·08
Reference region:				
NE-North-Brabant	0·10	0·03	0·05	0·10
Middle-Limburg	0·11	0·09	0·02	0·06
Twente	*0·03*	*0·02*	*−0·02*	*0·02*
Reference region:				
Aggl. Arnhem/ Nijmegen	−0·00	−0·02	−0·03	0·01
SE-North-Brabant	0·03	−0·00	0·02	0·06

Note: Periods in which the A1 was constructed are in italics.

ANALYSIS AT THE REGIONAL LEVEL

At the Corop level two research methods have been applied. In the first place a reference region method (quasi-experimental approach) has been used. In this method the employment growth in A1 regions has been compared with that of reference regions. These are comparable with the A1 regions in terms of economic structure and location, but in these regions little or no construction of main road infrastructure took place. Next, a regional labour market model has been constructed in which accessibility, via the main road network, is one of the main variables.

The reference region method

The first approach at the regional Corop level is the reference region method. First the development of regional employment will be compared with that in the remainder of the intermediary zone (see Fig. 2). Next the distinct regions will be compared with specific reference regions, which are also located within this zone (for a more detailed analysis we refer to BRUINSMA *et al.*, 1995a).

In Table 2 a comparison is made between the differential shift in the three A1 regions and the remainder of the intermediary zone and the distinct reference regions. When we compare the differential shifts in the periods of the opening of the A1, we find that in the Veluwe the shift is much higher than in the intermediary zone. At first sight this seems to be the result of the A1 construction. When the sectoral structure is investigated, however, it appears that the high differential shift is mainly caused by growth of the government sector, in the form of a growth in defence employment. It is not likely that this employment has been attracted by the construction of the A1.

When we inspect the other periods during which construction took place, we observe that the differential shift in Twente is somewhat higher in the period 1975–80. In the other relevant periods the shift is *lower* than in the intermediary zone, however. Also an investigation of lagged effects does not lead to clear results on an impact of highway construction on regional employment growth. So it is concluded that a positive influence of the construction of the A1 on the shift cannot be proven by using the remainder of the intermediary zone as a reference region.

Although it is certainly relevant to compare the development of the A1 regions with those in the intermediary zone, it is clear that the intermediary zone is not an entirely satisfactory reference region. The reason is that, in the periods concerned, other highway construction projects also took place in the intermediary zone. Therefore, a more detailed analysis with reference regions which did not experience extensive highway construction projects during the periods concerned has also been carried out (Table 2, Fig. 2). It appears that in eight cases an A1 region has a higher

differential shift than the reference region during a period of A1 construction. In one case the shifts were equal, while the shift is lower in 11 cases. Similar figures are found when a one period lag is assumed.

It may be clear that the results in this approach depend strongly on the reference regions chosen. It appears, however, that when other relevant reference regions are also chosen, the conclusion remains about the same. A problem is that this approach is rather crude, because no other specific features of the regions are taken into account, as is the case with the model approach. Clearly, in a relatively small country with only 40 statistical Corop regions, one cannot select reference regions in such a way that they satisfy all requirements for a quasi-experimental method (see ISSERMAN, 1990). Therefore, a multivariate approach is recommended as a complement to the reference region method. This is the subject of the next section.

The regional labour market model

A second approach at the regional Corop level is to use a regional labour market model. In the final estimation of the regional labour market model at the Corop level the differential shift in employment of a region during a five-year period is explained by:

- *acc* = the relative change in domestic accessibility
- *int* = the relative change in international accessibility
- *unemp* = the relative change in short-term unemployment
- *educ* = the relative change in the level of education
- *urb* = the level of urbanization
- *pol* = the regional policy variable (a dummy).

The results of these estimations are presented in Table 3. It appears that the change in domestic accessibility had a significantly negative impact on employment in the period 1970–75, while in the period 1985–90 this impact was positive. In the other periods no significant impact is found. International accessbility – made operational by accessibility to the main German and Belgian cities – does not have a significant impact on regional employment. Thus, a clear impact of a change in accessibility on the shift in regional employment cannot be proven.

Table 3. Results of regression analysis for the differential shift in employment

	1970–75 coefficient	1975–80 coefficient	1980–85 coefficient	1985–90 coefficient
acc	−0·94★	0·74	0·22	2·12★
int	0·08	0·20	1·47	−0·67
unemp	−0·01	0·22★	0·05★	0·15
educ	−0·54★	−0·09	0·03	−0·07
urb	−0·65★	−0·15	−0·19★	−0·28★
pol	−0·10★	−0·04	−0·06★	−0·07★
Constant	0·51★	−0·02	0·02	0·00
R^2	0·52	0·59	0·50	0·26

Note: ★Significant at 5% level.

Of the other variables the change in unemployment rate has a positive sign in two five-year periods; employment growth is higher in regions with a large increase in labour surplus. The level of education does not have the expected impact. The urbanization density has a significantly negative sign in three periods, which means that the urban–rural manufacturing shift (see KEEBLE *et al.*, 1983) has a stronger influence than agglomeration advantages. The regional policy has a negative significant sign in three periods, which may mean that the substitution effect of capital subsidies on employment is larger than the output effect. Another possible interpretation is that the regions receiving government support are regions with structural weaknesses, not incorporated by the other variables. Government policies are not strong enough to overcome these structural weaknesses and as a consequence a negative sign is found for the policy variable.

A sector where a significant impact of a change in accessibility on employment growth may be expected is the *transport and communication sector.* Regression results for this sector are reported in BRUINSMA *et al.*, 1995a; it appears that domestic accessibility has a significant positive influence on employment in this sector in the three periods between 1975 and 1990. The same accounts for the international accessibility in the periods 1970–75 and 1985–90. So it may be concluded that the change in accessibility has a positive impact on the development of employment in the transport sector. The other variables give about the same results as the model for total employment.

As far as the other economic sectors are concerned, domestic as well as international accessibility only have a significant influence on employment growth in a small number of cases. In an alternative specification we tested whether the accessibility variable has a different impact for importing and exporting sectors, but this did not yield better results for the individual sector estimates. The conclusion is that the transport and communications sector is the only one where a consistent impact of highway construction during several periods can be demonstrated at the Corop level.

Conclusions of the regional analysis

By using the reference region approach and the regional labour market model we could demonstrate a significant impact of highway construction on employment growth in the transport sector. For the other sectors and for aggregate employment growth no significant results were obtained. A reason for this negative result may be that the density of the network is already relatively high. In the case of the A1, however, this argument does not apply. In the first place the highway is entirely new and not an upgrading of an existing

road. Second, there is no alternative connection at the highway level available from and to the regions connected by the A1; in addition the completion of the A1 implies a high quality connection to the German road network. All other highways are located rather far from the research area. A possible explanation of these results is that the spatial scale level of Corop regions may be too high for our purpose. It is not impossible that at lower spatial levels such impacts may be found. This will be discussed in the remainder of this paper.

A SURVEY AMONG ENTREPRENEURS

In the last week of April 1994 1,845 questionnaires were sent to firms with at least 10 employees in the provinces of Overijssel and Gelderland. Only firms in sectors with a predominantly non-local orientation of demand have been included. The net response is 510 questionnaires (27·6%), which are representative of the target population according to location, sectoral composition and size (for a more detailed analysis we refer to BRUINSMA *et al.*. 1995b).

It may be argued that infrastructure does not only have objective effects (e.g. via transport costs), but that also subjective effects (e.g. status considerations) are important. Some of the answers of respondents on the importance of infrastructure will reflect both objective and subjective effects. In order to avoid the risk that respondents would perceive the questionnaire only from an infrastructure perspective, which might lead to biased results, in the questionnaire ample attention was paid to the broader context in which firms operate, as well as to firms' internal factors.

Infrastructure and firm development

Development of employment. The employment growth of the firms which responded was 52% in the period 1980–94, which is a very high growth rate. This can be explained by the fact that the companies selected have survived the recession period, or are starters in this period; so no questionnaires were sent to companies which became bankrupt, and to companies of which the number of employees fell under 10 employees. The industry sector, which accounts for most employment (48%) grew relatively slowly (27%) during the period considered. Most employment in the study area (65%) appears to be located within 5 km of a highway access. Also the main population centres and largest firms are found in this area, so this is not a striking finding.

Market perspectives and internal company considerations appear to be the main factors influencing employment growth (Table 4). In a previous research project in 1989 (BRUINSMA *et al.*, 1992) similar results were found for the Twente region. Other factors that are often mentioned as 'very' important are: availability of employees; accessibility by A1; accessibility by road; parking possibilities; expansion possibilities of buildings; representativeness of the location; and the price of the location. A closer look at these factors reveals that

Table 4. Perceived impact of (location) factors on employment growth and locational decisions (%)

	Growth in employees			Decision to relocate the firm				
				Push factors			Pull factors	
	1	2	3	1	2	3	2	3
Internal company considerations	24·0	19·6	22·8	24·8	9·2	7·4	7·4	2·5
Market perspectives	53·3	65·0	18·8	27·0	2·0	9·6	3·4	3·3
Education employees	6·6	1·8	4·8	0·9	0	0	0	0
Availability employees	12·7	2·4	13·2	4·7	0	1·1	0	0·8
Telecommunications	8·8	0·2	1·1	5·7	0	2·1	0	0·8
Accessibility by A1	12·9	0·7	2·2	17·8	2·0	1·1	8·1	3·3
Accessibility by road	10·9	1·3	5·9	21·6	7·8	12·8	13·4	9·9
Public traffic	3·5	0	0	5·6	0	0	0	0·8
Parking possibilities	10·1	0	0·3	16·2	0·7	9·6	1·3	1·7
Government	6·3	0·2	1·4	4·6	0·7	2·1	0·7	0
Image region	8·1	0·2	2·2	17·9	0	0	0·7	4·1
Expansion possibilities of buildings	25·6	6·2	13·5	54·3	61·4	16·0	45·0	19·0
Representativeness of location	16·6	0·7	2·2	46·6	4·6	25·5	8·7	31·4
Price location	14·2	0·2	1·7	26·0	1·3	3·2	5·4	13·6
Subsidies	7·6	0·4	2·0	15·5	0	0	2·7	5·0
Residential environment	7·5	0·2	2·2	14·4	7·8	6·4	2·7	0·8
Private factors	8·3	0·9	5·6	10·1	2·6	3·2	0	2·5

Notes: 1 = percentage of entrepreneurs that value the factor as 'very' important.
2 = percentage of entrepreneurs that value the factor as 'most' important.
3 = percentage of entrepreneurs that value the factor as 'second most' important.

infrastructure related factors (accessibility by road, accessibility by A1) are only considered as 'most' or 'second most' important in a small number of cases (this also holds true for the price, and the representativeness of the location). Thus, although infrastructure is often very important in the eyes of entrepreneurs, it is not often identified as 'most' or 'second most' important. Other factors are apparently more decisive in explaining the employment growth of individual firms.

New and relocated firms. Of the 510 firms surveyed, 100 started between 1980–94, while 182 relocated during that period. It is striking that of the 100 newly-started firms no less than 46 have relocated at least once in this period; obviously young (successful) firms are more mobile than other firms. The service sector appears to be most dynamic; the percentage of starters as well as relocations is the highest for this sector. The industry sector on the other hand is least dynamic.

When the distance to a highway is analysed, it appears that the rate of birth of new firms is higher in the zone up to 7·5 km of an access compared with zones further away (see Table 5). In addition, a high rate of relocation is found for firms within the 7·5 km zone (36·8%) compared with those in the longer distance zone (19·9%). This difference cannot simply be explained by the larger presence of new firms in the 7·5 km zone (new firms relocate more frequently). As shown in Table 5 the composition of relocating firms (in terms of firms already existing before 1980 and started up between 1980 and 1994) is not that different for both zones (80·5% and 76·7% versus 29·5% and 23·3%). In addition, firms already existing before 1980 are relocating more frequently in the 7·5 km zone. A possible explanation is that in this rather urbanized zone, opportunities for expansion at the same site are limited, so that expanding firms are forced to relocate.

When the relocated firms are analysed in more detail, it appears that 42% stay in the same four digit postal code area, while 74% stay in the same city or village. When the change in distance to a highway is measured, 41% of the firms appear to relocate towards a highway, while 16% of the firms relocate to a site at a larger distance. The average relative change in distance to an access due to a relocation is a decrease of 28%. Thus relocations of firms lead on average to closer proximity to highways. Another obvious reason why average distance to highways decreases is that new highways are constructed in the course of time.

As also shown in the 1989 study, market perspectives and internal company considerations are not the main factors for a relocation decision; these are only found as next important factors, together with the price of buildings and location, the accessibility by road infrastructure in general and, to a lesser extent, the A1 (Table 4). The most important factors appear to be the opportunity for building expansion and the representativeness of the location.

When a distinction is made between push and pull factors, it appears that the most important push factors are poor quality and building expansion opportunities and, to a lesser extent, bad accessibility by road, a residential environment and a shortage of parking space. On the other hand, the most important pull factors are expansion capacity, the representativeness and, to a lesser extent, the price and accessibility of the new location. An interesting conclusion that can be drawn from Table 4 is that road accessibility – and especially accessibility of the A1 highway – is more important as a pull factor than as a push factor in the location behaviour of firms. Only after entrepreneurs have decided to relocate do they start to attach a role of some importance to road accessibility.

Infrastructure components

In this section the importance of various infrastructure components will be discussed. First an analysis is presented of the infrastructure elements which are considered to be the most important by entrepreneurs. Next, entrepreneurial perceptions on infrastructure bottlenecks are discussed. Finally the values given by entrepreneurs to the impacts of the A1 construction on specific elements of the firms performance are discussed.

The impact of infrastructure in general. It appears that road infrastructure is valued often as 'most important'

Table 5. Distance to a highway access and the rate of birth and relocation of firms

Recent distance highway access	Number of firms in 1994	Existing before 1980	Birth between 1980–94		Relocation of firms: Total		Relocation of firms: Existing before 1980	Relocation of firms: Birth between 1980–94	
			No.	%[1]	No.	%[2]		No.	%[3]
< 7·5	359	277	82	29·6	132	36·8	93	39	29·5
> 7·5	151	133	18	13·5	30	19·9	23	7	23·3

Notes: 1. Percentage of firms existing before 1980.
2. Percentage of firms in 1994.
3. Percentage of the share in relocating firms.

Table 6. The importance of infrastructure (%)

	1	2	3	4
Roads	76·2	79·4	9·1	66·4
Railways	2·3	0·7	11·6	7·3
Waterways	2·6	1·3	4·0	3·8
Airports	5·2	0·4	4·5	17·0
Telecommunications	39·3	3·6	29·5	62·1
Public utilities	27·3	4·7	18·2	24·2
Terminals	4·3	0·4	4·8	8·9
No opinion		9·4	18·2	
Total		100	100	

Notes: 1 = % entrepreneurs that value the infrastructure component as 'very' important.
2 = % entrepreneurs that value the infrastructure component as 'most' important.
3 = % entrepreneurs that value the infrastructure component as 'second most' important.
4 = % entrepreneurs that noticed an increase in importance over the last five years.

(Table 6). Telecommunications is found to be next most important, while public utilities are valued a little lower. It may be clear that all these elements are intensively used by all firms, while airports and railways are used much less; these are accordingly valued much lower. As shown in the last column of Table 6 the changes in importance of infrastructure components during the past period are rather similar to the present, although certain shifts can be observed. Roads remain dominant but telecommunications and airports are often mentioned as infrastructure components of increasing importance.

We also investigated to what extent the present location of firms has an impact on the valuation of the importance of infrastructure (BRUINSMA *et al.*, 1995b). It appears that there are no significant differences between the valuations according to distance to highways. This also holds true for the valuation of highways: entrepreneurs with firms located further from the A1 did not value road infrastructure lower then entrepreneurs with firms nearby.

Bottlenecks in the infrastructure networks. Among the entrepreneurs 44% mention that they suffer from bottlenecks in infrastructure networks, especially in road infrastructure and, to a lesser extent, in telecommunications. Concerning road infrastructure, bottlenecks at all spatial levels are mentioned. At the *national* level especially, congestion – mainly in the western part of the Netherlands (the Randstad) – is experienced as a bottleneck. Thus congestion in the most highly urbanized part of the country does not only disturb firms located there, but also firms in the more peripheral parts of the country. It is striking that bottlenecks in the *international* road network are only mentioned in 1% of cases; in particular the connection with the German Ruhr area is mentioned. This may be considered very low, especially for a border region. It is an indication that there is in this case no serious mismatch between supply and demand for infrastructure in border regions. A similar result was found by BRUINSMA and RIETVELD, 1994, for a much broader set of European border regions.

The valuation of the importance of infrastructure components depends not only on the intensity of use, but also on bottlenecks experienced. This is the reason that road infrastructure and telecommunications figure prominently in Table 6. The low level of bottlenecks in services of public utilities explains why these receive lower scores in this table.

Impact of the A1 on the performance of firms. In the questionnaire the entrepreneurs were asked to consider the hypothetical case of the A1 highway *not* having been constructed. The impacts of the construction of the A1 highway on firms are described in Table 7. The impact is found particularly in increased accessibility and shorter travel times and, to a lesser extent, in the punctuality of goods supply. These results are not very striking since the research area is not suffering from serious congestion. It is striking, however, that the least positive impact is found for the size of the international market area. For a transnational transport corridor like the A1 these findings are rather disappointing. The impact of the construction appears to be smaller when the company is located further away from the A1. This holds true for the impact on sales as well as on accessibility. The impact on travel time is especially small when the site is located more than 7·5 km away from the highway.

When a sectoral distinction is made, we find that the most positive impacts are found for the transport and communications sector, which is consistent with the findings in the regional labour market approach (see above). For the service – and to a lesser extent the industry sector – relatively small impacts are obtained.

On the question of what the situation would be if the highways had not been constructed, some 10–20% of the entrepreneurs indicated that this would have had a negative impact on employment and the level of investment. These responses were mainly given by entrepreneurs located less than 7·5 km from a highway access (see Table 8).

Table 7. Impacts on firms of the A1 construction(%)

	Strong improvement	Improvement	No impact	No opinion
Accessibility	38·7	31·7	20·7	9·3
Travel time	31·9	38·9	20·1	9·2
Punctuality of deliveries	13·2	33·0	38·8	15·0
Sales	7·9	19·5	55·2	17·4
National market	9·8	19·6	54·4	16·2
Export market	5·6	12·3	63·0	19·2
Costs per unit	6·2	23·6	51·1	19·0

Table 8. Expected impacts on firms if the A1 was not constructed

	Agree	Disagree	No opinion
Company closed down	0·8	78·9	20·4
Company size enlarged	0·5	74·4	24·7
Company size smaller	6·9	66·0	27·2
Investments enlarged	17·0	56·8	26·3
Investments smaller	2·1	69·8	28·1
Expansion of employment	14·5	58·7	26·8
Less employment	2·1	69·8	28·1

In comparison to the 1989 study a substantially smaller share of the entrepreneurs indicated negative impacts of the non-construction. It appears that the positive impacts of the construction reported by entrepreneurs just after construction were less evident to entrepreneurs when they were interviewed some years later.

Conclusions of the survey

In the relation between transport infrastructure and economic development the perception of entrepreneurs about the importance of transport infrastructure is of major importance. A high consensus exists among entrepreneurs about the importance of road infrastructure and, to a lesser extent, telecommunications and public utilities. This common feeling about the importance of road infrastructure is partly reflected by actual location behaviour. The average distance to a highway access is decreased by 28% after the relocation of a firm. However, it is important to note that decrease in the distance to a highway access is not a main reason to relocate a firm. The main reason to relocate is the unsuitability of the old location. Moreover, the choice of the new location depends on the supply of industrial sites. In the period 1988–94 large industrial sites were developed near to highway ramps. This might partly explain the decrease in the average distance to a highway access of the relocated firms. Another indication for an impact of highway construction on economic development is found in the high percentage of entrepreneurs who stated that their companies' accessibility had improved and that the construction of the A1 led to a decrease in travel times. That less entrepreneurs experienced an increase in the reliability of delivery times seems convincing since there was hardly any congestion in the area before the A1 was constructed. The reliability of delivery times was and still is relatively high.

Other relationships between transport infrastructure and the vitality of firms are less convincing. Although entrepreneurs indicate that infrastructure in general, and the construction of the A1 highway, in particular, are of a definite importance for the development of employment, they clearly value market perspectives and internal company considerations higher. In addition, there is no clear indication of a tendency for decreasing impacts with increasing distances to highway access.

The questionnaire shows that the valuation of transport infrastructure by entrepreneurs is not only based on solid rational and objective reasons, like for instance transport costs. Other subjective reasons, like image effects, are involved. The impact of these subjective reasons might be considerable. If an improvement of the perceived attractiveness of an area by the construction of a highway leads to an increase in private investment, then public investment could be used to provoke private investment when applied in a proper manner. In 1994 the entrepreneurs indicate the impacts of the A1 construction to be considerably lower than in 1989. This means that there is a reduction in the perceived importance of the A1 over time.

CONCLUDING REMARKS

In this study the impacts of highway construction on employment have been investigated with data at different spatial levels. At the highest level of spatial aggregation – the Corop level – it appears that only the transport and communications sector benefits from the increased national and international accessibility caused by the construction of the A1 highway. For this sector *a priori* the biggest impacts were to be expected. When the reference region method is applied, it appears that no convincing indications are found that the A1 construction had a positive impact on total regional employment.

It may be concluded, therefore, that the impact of constructing highways on regional employment growth is not significant (except for the transport and communications sector). An explanation of this result may be that the spatial level of analysis used is too high to find clear spatial economic impacts. It is possible that spatial effects do exist, but that these relate to distribution effects *within* regions. Highway construction may, for example, lead to relocation of firms in a region to sites near an access point. In this case one does not observe an impact at the level of the region as a whole, but if data were available at a lower spatial level one might find relocation effects.

The survey approach makes it possible to carry out an analysis at the individual level and investigate spatial effects within regions. It appears that there is indeed a tendency of firms who are relocating to move to a location nearer to the highway. In addition a positive relation between the growth of companies and the distance to the A1 is found. Zones up to 7·5 km of the A1 have on average higher employment growth than zones at longer distances. A difficulty is that all major urban areas in the region are located within a distance of 7·5 km from the highway, so that distance to highway and degree of urbanization are strongly correlated. The zone up to 7·5 km of a highway is in

all respects most dynamic: total employment growth, new companies and relocating companies.

Since the highway studied here is an international link in the highway network it is interesting to consider the international component of its impact. This appears to be surprisingly small. The entrepreneurs indicate that the benefits for access to the national market are clearly higher than to the international market. Also in the study at the regional level, international accessibility plays a much smaller role than one might expect. This result is obviously relevant for discussions about Trans European Networks (TENs). There are probably more cases where the major contribution of TENs consists of an improvement for domestic rather than for international transport.

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